

ART. XVI.—*Experiments on Model Girders.*

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It has been the practice for several years past, in connection with the Engineering School of the University, to try various experiments upon the strength of model girders and frames, representing to scale existing or proposed structures. These experiments have, until recently, been made on wooden or cardboard models only. The desirability of testing iron models riveted together in the same manner as the actual structures, has all along been recognised, but practical difficulties in the way of obtaining the proper sections of metal in sufficiently small sizes, have hitherto prevented anything being done in this direction. Recently, however, a quantity of very small angle iron has been obtained, and this has removed the obstacle.

The first case chosen for experimental investigation was that of a small bridge for pedestrian traffic, crossing the lines of railway in the large goods station at Spencer-street. This structure is as a rule very lightly loaded, it rarely occurring that more than two or three persons are upon it at once, but, at the same time, it is quite within the bounds of possibility for a dense crowd to assemble upon it, testing its endurance to the utmost, and rendering any weakness a matter of most serious importance. The reasons why this particular bridge was selected were, first, that its construction being comparatively simple, the labour of making the model was but moderate; and, second, that calculation based upon established dynamical laws led to the conclusion that some parts were considerably deficient in strength, while others were needlessly lavish, both in material and the amount of riveting employed. The former criticism applies to the compression diagonals, which consist merely of thin flat bars, while the latter refers to the end vertical pieces, which are of comparatively massive and complex construction, containing many times the quantity of iron theoretically necessary.

The model marked A represents accurately to a scale of one-twelfth full size one of the girders of this structure. That marked B is constructed according to an amended

design, characterised by the strictest adherence to the indications of mathematical calculation compatible with simplicity of construction. In general appearance, girder B is hardly distinguishable from A; a close inspection reveals the following differences—(1) The replacing of the massive ends, each of which consists of five separate pieces of metal united by numerous rivets, by a single angle iron; (2) The omission of certain minor vertical members, upon which there is no calculable load; (3) The introduction of angle irons instead of the plain flat bars for the compression diagonals. The time taken in construction was carefully noted, also the weight of metal, number of rivets, and other particulars, for which see subjoined tabular statement. The great reduction in the amount of time expended in the case of girder B was due mainly to the simplification in the construction of the end vertical pieces.

In testing, the girders were supported and loaded exactly as in the actual structure, the top members being braced to prevent lateral deflection. The difference in strength, and the mode and nature of the fracture in each case, was in accordance with what was predicted on theoretical grounds.

	GIRDER A.	GIRDER B.
Weight of metal	... 1 lb. 9 oz. 1 lb. 5 oz.
Time occupied in making	14 hours 10 minutes	5 hours 30 minutes.
Actual breaking load	208 lbs. 771 lbs.
Calculated ditto	182 lbs. 800 lbs.
Ratio of breaking load to weight of girder	133 to 1 587 to 1.
Nature and position of fracture	Buckling of compression diagonals, leading to general collapse of structure	Terminal tension diagonal torn across through rivet hole.
